STANDARD OPERATING PROCEDURE

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Sampling of Vapor-Port-Equipped Monitoring Wells at MDA G and L	**ER-SOP-6.30**	**0**	**12/03/99**
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ER PROJECT

LOS ALAMOS NATIONAL LABORATORY

Sampling of Vapor-Port-Equipped Monitoring Wells at MDA G and L

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Sampling of Vapor-Port-Equipped Monitoring Wells at MDA G and L

NOTE: Environmental Restoration (ER) Project personnel may produce paper copies of this procedure printed from the controlled-document electronic file located at http://erinternal.lanl.gov/documents/Procedures/sops.htm. However, it is their responsibility to ensure that they are trained to and utilizing the current version of this procedure. The Quality Program Project Leader may be contacted if text is unclear.

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the method for sampling pore gas from monitoring wells equipped with vapor sampling ports using SUMMA passivated canisters for the analysis of volatile organic compounds (VOCs). This procedure was developed for the Environmental Restoration Project monitoring of VOCs in the subsurface near Material Disposal Area (MDA) L at TA-54, and may be useable for similar situations where pore gas has elevated concentrations of VOCs.

2.0 TRAINING

2.1 The **field team members** should be familiar with the objectives of canister sampling for VOCs and, in accordance with QP-2.2, must document that they have read and understand this procedure. A general knowledge of Environmental Protection Agency (EPA) Method TO-14, "Determination of Volatile Organic Compounds in Ambient Air Using SUMMA Passivated Canister Sampling and Gas Chromatographic Analysis," is helpful.

2.2 A knowledge of the goals of the MDA L pore gas sampling program as described in the Operable Unit (OU)-1148 Work Plan (Chapter 1, page 31) and Notice of Deficiency (NOD) response (OU-1148 Work Plan AppendixA) is also required.

2.3 The **Field Team Leader** (FTL) will monitor the proper implementation of this procedure and ensure that relevant team members have completed all applicable training assignments in accordance with QP-2.2.

3.0 DEFINITIONS

3.1 *B&K gas analyzer* — A portable field instrument manufactured by Bruel and Kjaer: model 1302 infrared photoionization acoustic volatile organic detector, photoionization detector. This detector is used at MDA L to detect trichloroethane (TCA), trichloroethene (TCE), freon-11, freon-113, carbon dioxide (CO_2), and water vapor.

3.2 *Landtech* — A field-portable instrument used to measure CO_2, Oxygen (O_2), and methane (CH_4).

3.3 *Passivated* — A chemical treatment for tubing which renders the material free of active sites; therefore VOCs do not attach to these surfaces.

3.4 *Pore gas* — The gas that fills the interstices in tuff. (As a point of interest it should be noted that tuff has little to no affinity for the absorption of VOCs. Therefore, VOCs trapped in tuff will be in the vapor phase. A gas-sampling technique for VOCs in tuff should therefore be used as opposed to sampling the tuff itself.)

3.5 *Porosity* — The ratio of the volume of interstices in rock or soil to its total volume expressed as a percentage or as a fraction.

3.6 *Sample train* — The tubing and valves which connect the well vapor sample port to the SUMMA canister, screening equipment, and (as necessary) purge pump.

3.7 *Site-Specific Health and Safety Plan (SSHASP)*—A health and safety plan that is specific to a site or ER-related field activity that has been approved by an ER health and safety representative. This document contains information specific to the project including scope of work, relevant history, descriptions of hazards by activity associated with the project site(s), and techniques for exposure mitigation (e.g., personal protective equipment [PPE]) and hazard mitigation.

3.8 *SUMMA canister* — Canisters that are specially treated using the SUMMA passivation process in which pure chrome-nickel oxide is formed on the interior surfaces of the sample canister.

3.9 *Tedlar* — Tedlar is a registered trademark of the Dupont Corporation for a polyvinyl film that has very low gas-permeation levels, high tensile strength, and resists punctures. Tedlar is also chemically inert and recommended for many EPA test methods.

3.10 *Tedlar bag* — A gas-sampling bag used to collect airborne or gas chemical hazards, made of Tedlar and fitted with an inert on/off fitting to introduce the sample into the bag.

3.11 *Tuff* — A compacted deposit of volcanic ash and dust that contains rock and mineral fragments accumulated during an eruption.

3.12 *Visalia* — A field-portable instrument used to measure CO_2.

4.0 BACKGROUND AND PRECAUTIONS

Note: This SOP is to be used in conjunction with an approved SSHASP. Also, consult the SSHASP for information on and use of all PPE.

4.1 Background Information

4.1.1 Subatmospheric sampling of borehole vapor ports involves the use of evacuated canisters, a purge pump, and screening instruments that are plumbed together with passivated nickel tubing (the sample train). The samples collected by this method are grab samples and no flow regulation is required.

4.1.2 The sample train is comprised of passivated nickel tubing and stainless steel valves with compression fittings, a vacuum gauge, a field analytical instrument for organic vapor screening, a landfill gas analyzer or CO_2 analyzer, and a SUMMA sample canister. A schematic of the sample train is given in Attachment A. The valve serves to isolate each element of the system from the others so only a single element of the system is allowed to draw from the vapor port at a given time. The pump is used to purge the gas port. The landfill gas analyzer or CO_2 analyzer is used to determine if soil pore gas is equilibrated in the sampling train. The field analytical instrument is used to measure the concentration of selected VOCs. A vacuum gauge is incorporated into the system and aids in determining if leaks are present in the sample stream, if a well port is blocked, and if the SUMMA canister is full.

4.1.3 It is critical that canisters are properly cleaned and leak free to ensure sample quality. The cleaning and certification process is outlined in ER-SOP-6.22, Canister Sampling for Organics - EPA Method TO-14. The decontamination and certification process is very involved. For applications of this SOP to MDA L, it is required that certified clean canisters be obtained through the Laboratory's Sample Management Office (SMO) from the contract laboratory where the samples will be analyzed.

4.1.4 The use of a gas monitor capable of measuring oxygen (O_2), carbon dioxide (CO_2), and methane (CH_4) (for example Landtech model GA-90) is suggested during sampling operations. In general, soil pore gas is depleted in O_2, elevated in CO_2, and at landfill sites, may also contain CH_4. During purging of the sample port, monitor the levels of these three gasses to determine if soil pore gas is being sampled. Use Table 4.1-1 as a guide for the ratio of these three gases for different sites.

Table 4.1-1
Ratio of Soil Pore Gas Composition

Soil Pore Gas Classification	Percent Oxygen (O_2)	Percent Carbon Dioxide (CO_2)	Percent Methane (CH_4)
Ambient air	21	Nondetectable	Nondetectable
Typical soil pore gas	19	2	Nondetectable
Landfill soil pore gas	Nondetectable	24	30
Soil pore gas near a hydrocarbon spill	2	19	Nondetectable
MDA L soil pore gas	15–18	1–4	Nondetectable

4.1.5 Observe the changing ratio from ambient air to a characteristic subsurface gas ratio to ensure that the sample train is properly purged and a representative pore gas sample has been obtained.

4.1.6 Use the ratios presented in Table 4.1-1 as a cursory check of the pore gas being purged. However the stabilization of the CO_2 concentration can serve as the primary indicator that a representative pore gas sample has been achieved. CO_2 detectors, which are sensitive to 0.01%, are recommended for ensuring that proper purge volumes have been removed. (For MDA L and G, the time for this purge will vary depending on the well tubing size and depth. The time will vary between 1-5 minutes). For MDA L the Visalia portable CO_2 detector is used for this purpose. During purging, stabilization of the CO_2 concentration to the hundredth percentile indicates that a consistent gas sample is being drawn and therefore a complete purge has been achieved. This eliminates the need for flow meters and calculating the volume of the sample tube to determine if an adequate volume of gas has been purged from the port.

4.1.7 Pore gas is saturated with water vapor at about 10°C, depending on depth. It is imperative that the gas standards also be saturated with water vapor at 10°C, because the B&K gas analyzer corrects its VOC results for water vapor. If the calibration standards are dry, they cannot be accurately utilized as calibration standards for pore-gas work.

4.1.8 Volatile organic gas calibration standards with a dew point of 10°C are not standard off-the-shelf items for gas suppliers. For MDA L, Scott Specialty Gas supplies two gas standards with a dew point of 10°C (43 parts per million by volume [ppm_v] water). The high calibration standard has TCA at 500 ppm_v and TCE at 100 ppm_v, and the low standard is 50 ppm_v TCA and 10 ppm_v TCE.

4.2 Precautions and Safety Issues

4.2.1 Sample canisters must be handled properly. Do not store canisters in direct sunlight and keep them at ambient temperatures before and after collecting samples. Tighten all fittings in the sampling system as necessary (about ¼ turn past finger tight) before sampling to ensure that the sampling train is free of leaks. Swagelok fittings are recommended. Use Teflon tape (as appropriate) on pipe fittings.

4.2.2 Use instruments that provide a direct reading in the field to assess the levels of volatile organic contamination in the pore gas. This information can be used for health and safety purposes, site characterization, and to assist the analytical laboratory in determining appropriate sample dilutions. Vent the gas outlets of all direct-reading instruments and pumps through tubing to a downwind location to prevent exposure of the field team to organic vapors.

4.2.3 Most direct-reading instruments are battery powered. Some equipment may require a 110-volt power supply. Where practical, a deep cycle 12-volt battery and an inverter are recommended rather than a portable generator. The exhaust from gas-powered generators is a source of potential sample contamination. When using portable gas powered generators, locate them downwind from the sample location to reduce the risk of sample contamination from generator exhaust.

4.2.4 During sampling operations, personnel safety procedures must be observed to prevent exposure to hazardous materials and physical hazards. This includes standard safety practices and site-specific requirements as determined by the site safety officer (SSO) and the SSHASP.

4.2.5 This procedure may require the use of compressed gas cylinders (for field-instrument calibration and quality-assurance and quality-control [QA/QC] samples), pumps, and field screening instruments. All equipment and materials must be handled in a safe manner that is consistent with the limitations stated by the manufacturer. Carefully read all warning labels associated with the equipment. Obtain Material Safety Data Sheets (MSDSs) for all compressed gases and reagents from the SSO or the manufacturer and make certain all field team members have reviewed them before the start of sampling operations. If new reagents or compressed gases are obtained for the sampling operations, make certain that the SSO and field team members are aware of this and provide a copy of the MSDS to the SSO. Make certain that all PPE as required in the SSHASP or by the SSO are properly used at all times during the sampling operations.

4.2.6 Use and handling of compressed gas cylinders should be done in compliance with the Laboratory Fire Protection Program Manual, *Compressed Gas Cylinders*, Rev. 0, June 6,1998, or future updates thereof. Further instructions should be obtained from LIR 402-1200-01.0, *Pressure, Vacuum, and Cryogenic Systems*.

5.0 EQUIPMENT

Equipment required to perform subatmospheric canister sampling of vapor-port-equipped monitoring wells includes, but is not limited to

- certified clean SUMMA canisters;
- Visalia CO_2 detector for measuring CO_2 or Landtech model GA-90 for monitoring CO_2, O_2, and CH_4, B&K gas analyzer model 1302 infrared photoionization acoustic volatile organic detector, photoionization detector, flame ionization detector, or other appropriate monitoring instruments;
- vacuum pump and rotameter (flow meter) or calibrated sampling pump (if needed);
- passivated nickel tubing and stainless steel valves to connect the elements of the sampling train to the vapor port;
- compressed dry nitrogen (ultra-high purity grade) or zero air (contaminant free) supply for purging the sampling train;
- calibration gases for field instrument calibration;
- generator or deep cycle battery with inverter to power monitoring equipment;
- field documentation and support equipment; and
- safety equipment as required by the SSO and/or SSHASP.

6.0 PROCEDURE

Note: Deviations from SOPs are made in accordance with QP-4.2.

The following instructions are based on the assumption that a multiple port (multiple depth) monitoring well is to be sampled. All ports will be sampled with the B&K. According to the OU-1198 Workplan, the SUMMA canister for the analysis of VOCs by EPA Method TO-14 will be collected from the port with the highest level of VOC contamination. This multiple-port sampling requires that all ports be purged and screened before collecting the canister samples. For sampling events where only a specific port is to be sampled, limit the screening to that specific port.

6.1 Preparing the Sample Train

Assemble a sample train from passivated nickel tubing and stainless steel valves as appropriate for the equipment to be used in the sampling effort.

The use of compression fittings (e.g. Swagelok) is suggested as it allows the tubing and valves to be disassembled after the sampling effort for inspection and decontamination.

6.2 Preparing the Bruel and Kjaer Gas Analyzer

Note: For the field-screening and sample-collection work described in the following sections, an appropriate field logbook, prepared in accordance with QP-5.7, is required. An example page from the field logbook prepared for the pore gas sampling at MDA L is provided as Attachment B of this document.

6.2.1 Program the B&K Gas Analyzer

Program the B&K model 1302 infrared photoionization acoustic volatile organic detector for the task at hand. For initial compound selection and calibration, the factory will need to setup the B&K gas analyzer. For field-condition parameters such as length of the sample-train tubing, results units, and ambient pressure, follow the B&K manufacturer's operating manual to set up the method for each task. At MDA L the B&K analyzes for TCA, TCE, freon-11, freon-113, CO_2, and water vapor.

6.2.2 Analyze Ambient Air

At each well, after the B&K gas analyzer has run through its self-test and is stable and ready for samples, analyze three ambient air samples.

6.2.2.1 Ensure that the B&K inlet is not connected to the sample train but is instead open to the ambient air.

6.2.2.2 With the B&K inlet open to atmosphere, select the B&K gas analyzer's "Start Analyses" function. Consult the instructions provided in the manufacturer's operating manual for futher information.

6.2.2.3 Record the results for these samples in the field logbook. The B&K gas analyzer should detect no VOCs for these three ambient air samples.

6.2.2.4 If VOCs are detected, take corrective measures before continuing with pore gas sampling. These corrective measures include

- analyzing zero grade air (to determine if VOCs are present in the ambient air) or
- recalibrating the B&K according to the instructions provided in the manufacturer's operating manual.

At some areas at the center of MDA L, it is possible that VOCs may be present in ambient air. For the ambient air samples, CO_2 should be in the range of 300–600 ppm_v. The water vapor measurement will vary depending on local conditions.

6.2.3 Check the Calibration of the B&K Gas Analyzer

After the ambient air analyses but before screening each well, it is important to perform a calibration check on the B&K.

6.2.3.1 For each sampling event, label two new Tedlar bags—one as the low calibration standard and one as the high calibration standard (never directly mark Tedlar bags with magic marker as this may potentially contaminate the bags with the VOCs used in the markers, use a label on the Tedlar bag instead). It is also important to note that Tedlar bags should be protected from direct sunlight because some analytes may be degraded by exposure to direct sunlight.

6.2.3.2 Fill the Tedlar bags to full expansion from the calibration gas cylinders, one with the low calibration standard, and one with the high calibration standard.

6.2.3.3 Attach the low calibration Tedlar bag to the inlet of the B&K for analysis. The results should be within ±30% of the certified value for the gas standard or you must take corrective measures before continuing with pore gas sampling. These corrective measures include

- using calibration gas from another Tedlar bag,
- using calibration gas from another calibration gas standard, or
- recalibrating of the B&K according to the instructions provided in the manufacturer’s operating manual.

6.2.3.4 Next, analyze the high standard. Again, the results should be within ±30% of the certified value or you must take corrective measures (as listed above) before continuing with pore gas sampling.

6.2.3.5 After the calibration has been performed and the acceptance criteria have been met, the well can then be sampled and analyzed as detailed below. Record all calibration results in the field logbook. If these criteria can not be achieved the sampling must be stopped and the B&K must be sent to the manufacturer for service and calibration.

6.3 Purging and Screening Vapor Ports

Before the start of a sampling event, inspect all fittings and valves that make up the sample train, tighten as necessary, and test for leaks with a vacuum gauge. After the initial setup of the field screening equipment at the well to be sampled, perform the following steps for the gas ports at all depths.

6.3.1 Purging

6.3.1.1 Beginning with the shallowest well depth, purge the gas port using the pump on the landfill gas analyzer or an accessory pump. An accessory pump should only be necessary if the pump on the gas analyzer does not have sufficient back-pressure to pull a pore gas sample from the monitoring well.

6.3.1.2 Allow purging of the port to continue until gas concentrations stabilize.

6.3.1.3 After the purge is complete, close the gas analyzer off from the system and record the measured concentrations in the field logbook.

6.3.2 Screening

6.3.2.1 Screen the soil gas for VOCs by opening the valve from the appropriate field analytical instrument to the well port sampling line. For monitoring at MDA L, a Bruel and Kjaer model 1302 photoacoustic detector is used to analyze for TCA, TCE, freon-11, freon-113, CO_2, and water vapor. The CO_2 concentration should be stable and consistent with the purged values. Subsequent soil pore gas concentrations should remain constant if the sample stream is free of leaks and a proper purge was achieved.

6.3.2.2 Following completion of the analysis, close off the instrument from the sampling line and record the results in the field logbook.

6.3.2.3 If the pump on the sampling train does not have enough back-pressure to pull a pore gas sample because the well is constructed with small-diameter tubing or if the tubing is partially blocked, use the lung box in the pore gas sample train to draw samples. The lung box consists of sealed box in which an empty Tedlar bag is located and attached to the inlet port.

1) Attach the lung box to the well sampling port sampling line and open the valve on the Tedlar bag.

2) Use the vacuum pump to remove the air from the box that surrounds the bag; this subsequently creates a vacuum in the bag and fills the bag with pore gas from the port.

3) Once the bag is full, seal the port, close the valve on the Tedlar bag, and switch off the vacuum pump.

4) Disconnect the lung box from the well sampling port sampling line.

5) Remove the full Tedlar bag from the lung box to be sampled by the B&K.

6.3.3 Repeat for all Sampling Ports

Connect the sample system to the next deepest port and repeat the steps of Sections 6.3.1 and 6.3.2. Continue this procedure until all gas ports have been purged and screened.

6.4 Collecting Quality Assurance/Quality Control Samples

The following types of field QA/QC samples are required.

6.4.1 Duplicate Samples

Duplicate samples are used to check the precision of the analysis. Take a duplicate sample in the same manner as the regular samples, with a frequency of one duplicate per 20 samples or, at least, one duplicate per field-sampling event.

6.4.2 Equipment Blank

Collect an equipment blank, which consists of a SUMMA canister filled with zero grade (contaminant free) air or nitrogen through a decontaminated sampling train at least once per field sampling event. This will be used to check the effectiveness of the sample-train decontamination procedure (flushing with zero grade air).

6.5 Collecting Canister Samples

Once all ports have been screened, the MDA L sampling plan calls for the port with the highest concentration of TCA to be selected for collection of a SUMMA canister sample. The choice of the well port with the highest concentration of TCA is appropriate for the regulatory work at MDA L. The strategy for other ER Project sites may be different.

6.5.1 Attachment B of this SOP provides an example page from a pore gas sampling field logbook. As the following steps in this procedure are completed, record sampling data in **all** of the fields on this sheet. These include the well ID, SUMMA canister ID, SMO sample ID, sampling date and time, atmospheric temperature and pressure, SUMMA canister vacuum pressure, SUMMA canister pressure when filled, concentrations of calibration standards, all B&K data, and port conditions.

6.5.1.1 Connect the system to the appropriate port and repeat the steps in Sections 6.3.1 and 6.3.2 to ensure that a representative soil pore gas sample will be collected.

6.5.1.2 Connect the SUMMA canister to the sample train.

6.5.1.3 Close off all elements of the system from the well gas port.

6.5.1.4 Open the valve on the SUMMA canister.

6.5.1.5 Check the vacuum gauge for proper vacuum on the SUMMA canister and for leaks in the sample stream.

6.5.1.6 If no leaks are detected, open the valve between the well gas port and the canister and draw the sample into the canister by differential pressure (SUMMA canisters are evacuated to a pressure of 0.05mm Hg during the cleaning process).

6.5.1.7 When pressures have equilibrated, close the valves on the canister and subsurface collection system.

6.5.1.8 Following the collection of the sample, disconnect and label the canister and complete the sample-collection log.

6.5.1.9 Place the canister in the shipping container for transportation to the SMO, which ships it to the contract laboratory for analysis of VOCs using EPA Method TO-14. Follow ER-SOP-1.03 for this step. Provide a copy of the field-screening results to the SMO to assist the contract laboratory with analyzing the samples at the proper dilution.

6.6 Decontaminating Equipment

6.6.1 Disposable Sampling Equipment

All disposable sampling equipment must be segregated, contained, and disposed of using approved waste-management procedures as per ER-SOP-1.06.

6.6.2 Passivated Nickel Tubing

Decontaminate all tubing that makes up the sampling train in the following manner.

6.6.2.1 Following the sampling of a well, pump nitrogen or zero air through the sample train to evacuate residual pore gas or vapor. Because passivated nickel does not trap VOCs, liquid decontamination of the interior of the tubing is not required.

6.6.2.2 Use the field analytical/screening instrument (B&K) to ensure that no contaminants are present in the tubing. Should screening indicate the presence of residual contamination, reflush the sample train with zero grade air and screen the train again.

6.6.2.3 Should the sample train remain contaminated, disassemble it and decontaminate all valves and fittings as described in Section 6.6.3.

6.6.2.4 Dispose of any tubing that is visibly damaged or contaminated.

6.6.3 Valves and Fittings

For a sampling train in which screening or equipment blanks indicate contamination is present, all stainless steel valves and fittings must be decontaminated as described below. Note that passivated nickel components do not require this wet decontamination process.

6.6.3.1 Wash the valves and fittings with 50:50 solution of Alconox or Liquinox and water.

6.6.3.2 Rinse the valves and fittings with potable water and allow them to air dry.

6.6.3.3 Provide a final rinse of the valves and fittings with de-ionized water and allow to air dry before reuse.

6.6.3.4 Segregate, contain, and dispose of all solutions produced during the decontamination process using approved waste-management procedures as per ER-SOP-1.06.

7.0 REFERENCES

The following documents have been cited within this procedure.

AP-02.1, Procedure for LANL ER Records Management

EPA, May 1988. Compendium Method TO-14 “The Determination of Volatile Organic Compounds in Ambient Air Using SUMMA Passivated Canister Sampling and Gas Chromatography Analysis.”

ER-SOP-1.03, Handling, Packaging, and Shipping of Samples

ER-SOP-1.06, Management of Environmental Restoration Project Wastes

ER-SOP-6.22, Canister Sampling for Organics - EPA Method TO-14

Laboratory Fire Protection Program Manual, "Compressed Gas Cylinders, Rev. 0," June 6,1998, or future updates thereof

LANL, 1992. "RFI Work Plan for Operable Unit OU-1148," Los Alamos National Laboratory Report LA-UR-92-855, May 1992, (LANL 1992, 7669).

QP-2.2, Personnel Orientation and Training

QP-4.2, Standard Operating Procedure Development

QP-5.7, Notebook Documentation for Environmental Restoration Technical Activities

VM-5.0, Instruction Manual, Volume 1, Operation and Maintenance—Multi-gas Monitor Type 1302

8.0 RECORDS

The **FTL** is responsible for submitting the following records (processed in accordance with AP-02.1) to the Records Processing Facility.

8.1 Chain-of-Custody/Request for Analysis Forms

8.2 Sample Collection Log Forms

8.3 Daily Activity Log in the form of a field logbook that details all sampling and field activities and all pertinent field data (i.e., Field Data Forms [Attachment B])

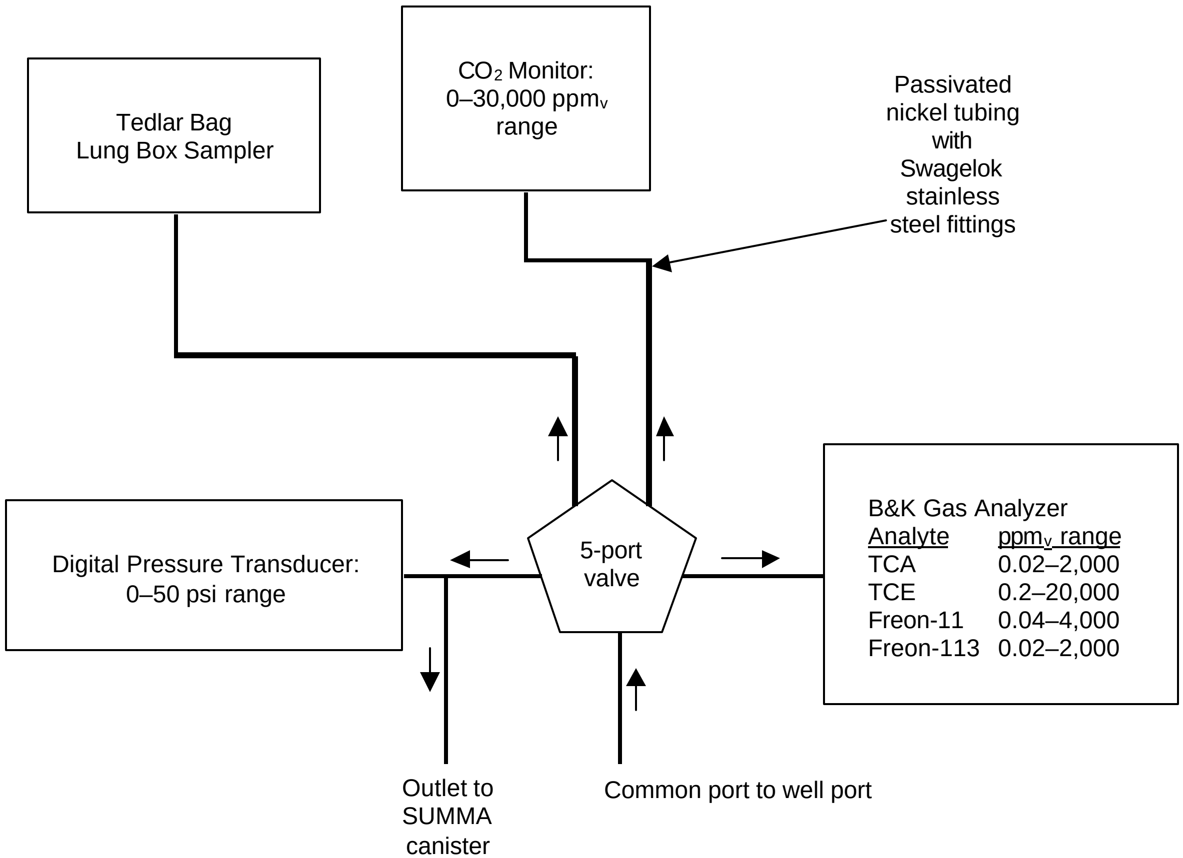
9.0 ATTACHMENTS

The document user may employ documentation formats different from those attached to/named in this procedure—as long as the substituted formats in use provide, as a minimum, the information required in the official forms developed by the procedure.

Attachment A: Schematic Diagram of a Sampling Train (1 page)

Attachment B: Example Page from an MDA L Field Logbook (1 page)

Schematic Diagram of a Sampling Train



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Example Page from an MDA L Field Logbook

Well Number: __________________ Sampling Date: ____________________

Analytical Laboratory: ____

SUMMA Canister ID: ___________________ SMO Sample ID: ___________________

Atmospheric Pressure: ____________ Temperature: ______°C

SUMMA vacuum pressure: ______________psi

SUMMA pressure when full: _____________psi

Low standard: TCA = 50 ppm_v, TCE = 10 ppm_v

High standard: TCA = 500 ppm_v, TCE = 100 ppm_v

Depth (ft)	**Time**	**TCA (ppm_v)**	**TCE (ppm_v)**	**Freon-11 (ppm_v)**	**Freon-113 (ppm_v)**	**CO_2 B&K (ppm_v)**	**Water Vapor (ppm_v)**	**CO_2 Visalia (%)**	**Port Condition**
Ambient 1									
Ambient 2									
Ambient 3									
Low standard									
Purge									
High standard									
45 ft.									
187 ft.									
350 ft.									
385 ft.									
435 ft.									
485 ft.									
525 ft.									
SUMMA 350 ft.									